



THE "DEMAND-PULL" AND "COST-PUSH" HYPOTHESES.

AN ANALYTICAL COMPARISON*

A. Zabalza
London School of Economics

J. Piggott
University of Adelaide

J. Lambe
H. M. Treasury

Working Paper 79-2

* We gratefully acknowledge the help and encouragement given us by Professor M. Parkin. S. Glaister, P. Jacobs and R. Layard also offered helpful comments. All responsibility for remaining errors rests with the authors.

I. Introduction.

The inflationary experience of the world's industrialised nations over the last half decade has given new impetus to the demand-pull cost-push controversy. The more orthodox demand-pull view has been presented in its purest form by Friedman (1968). By carefully defining his "natural" rate of unemployment*, and then treating it as equivalent to the full employment level, he excludes the possibility of an inflation generated by cost factors.

This conventional analysis has come under attack because it does not appear able to explain the "new" inflation (Jones, 1973), where increasing rates of unemployment are sometimes associated with increasing rates of price change. At least one writer (Wiles, 1973) has claimed that conventional economic theory has nothing to say about this phenomenon, and that its origins are sociological. Others, notably Hicks (1974), have presented alternative accounts of inflation along cost-push lines.

It is now generally recognised that to understand the inflationary process, it is necessary to study the interaction of the labour, goods, and money markets.** There have, however, been few, if any, attempts to construct a formal model of this "complete" kind which is capable of analyzing cost inflations. The purpose of this paper is to modify and extend a "demand-pull" model of Laidler's (1973) so that it will capture the cost-push case, and to compare the analytic implications

* Friedman defines the "natural" rate of unemployment as "the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labour and commodity markets, ..." See Friedman (1968), p. 8.

** See Laidler and Parkin (1975).

of the two variants for an economy which is assumed to be closed. It is hoped that this exercise will help to clear up some of the confusions surrounding the relation between the two schools of thought.

We approach the problem by means of a simple dynamic model of the labour market. Laidler's model is then re-interpreted in terms of the adjustments taking place in the market for labour services, and extended to allow government monetary policy to be treated as an endogenous factor, varying as a function of the unemployment level. In the cost-push case we represent those social factors which "push" theorists claim are important in generating inflation by a proxy variable π , which enters as an exogenous determinant of the supply of labour.

In the next section we derive the basic model which is used in the analysis, and we investigate its properties under the assumption that monetary policy is exogenous. This is the familiar "demand-pull" analysis of the effects of changes in the money supply on the rate of unemployment and inflation. The cost-push variant of the model is described in section III, together with an analysis of the effects on prices, wages, employment, and the rate of monetary expansion. In section IV, the two hypotheses are compared, and some of their implications are discussed.

II. The Basic Model and the Demand-Pull Hypothesis.

II. 1. A disequilibrium model of wage and price inflation

We begin with a very simple model of the labour market. It is assumed that the demand for labour depends negatively, and the supply of labour positively, on real wages. It is further assumed that while employers always know the

current price level, workers are not immediately aware of price level movements*. They decide whether to accept a given money wage offer on the basis of their expectations about current prices. Assuming that these relationships are linear in logarithms, we may write

$$L^S = \alpha + \beta (W - P_{-1}^e)$$

$$L^d = \mu - \sigma (W - P)$$

where L^S , L^d , W , P , and P^e represent the logarithms of labour supply, labour demand, the rate of money wages, the price level, and the expected price level, respectively, and where the subscript -1 refers to a lag of one period. When $P_{-1}^e = P$, the above two equations give us the equilibrium values of this market: $L^* = (\beta\mu + \sigma\alpha) / (\beta + \sigma)$, and $(W-P)^* = (\mu - \alpha) / (\beta + \sigma)$.

When actual prices do not coincide with expectations, however, the equations represent a disequilibrium system. Since our main concern in this paper will be with processes of adjustment to equilibrium positions, its disequilibrium properties must be investigated. Rewriting the supply equation as $L^S = \alpha + \beta W - \beta [P - (P - P_{-1}^e)]$, and making $L^S = L^d$, we have

$$(W - P) = (W - P)^* - \frac{\beta}{\beta + \sigma} (P - P_{-1}^e) \quad (1)$$

That is, the real wage will be below its equilibrium level, as long as expected prices are below actual prices. Substituting (1) back into either of the two behavioural equations of the system, we have

$$L = L^* + \frac{\beta\sigma}{\beta + \sigma} (P - P_{-1}^e) \quad (2)$$

* The assumption of perfect information on the demand side is made for simplicity only. It is, however, necessary that the speeds of adjustments of demanders' and suppliers' expectations be different.

which tells us that while workers' price expectations are below the actual price level, the quantity of labour services traded will be greater than the equilibrium quantity.

Figure 1 represents these results diagrammatically. The disequilibrium system is represented in the upper panel, while the corresponding equilibrium relationships are shown in the lower panel. Assume that initially, the system is in equilibrium at point A, and that the price level then increases from P_0 to P_1 . Employers are immediately aware of the new level of prices; their demand function in terms of nominal wages (Panel 1) shifts from $L^d(P_0)$ to $L^d(P_1)$. Workers, however, are at first unaware of the change in prices, and their supply function thus remains in its initial position at $L^s(P_1^e = P_0)$. The system is now at point B, where the quantity of labour services has increased from L^* to L_1 , the nominal wage has increased to W_0^1 , and the real wage is $(W_0^1 - P_1)$. Since employers know the actual price level, the quantity of labour they demand must be consistent with their equilibrium behaviour. They will, therefore, still be on their equilibrium schedule (point B, panel 2); the new real wage $(W_0^1 - P_1)$ will be below its equilibrium value $(W - P)^*$.

The system is, at this stage, prevented from attaining an equilibrium by the illusion about the price level entertained by the suppliers of labour. Both workers and employers are behaving consistently given the information at their disposal. As they acquire more information about the price level, workers will offer less labour for any given nominal wage (i.e., their supply schedule in panel 1 will start shifting to the left). This shift, increasing real wages and decreasing the quantity of labour supplied, will continue until workers are fully informed about the level of prices, at point D in panel 1 (A in panel 2). Real wages and employment will regain their equilibrium levels; only nominal variables $-W$ and $-P-$ will have changed.

The above discussion includes the basic elements of the argument that explains the process of adjustment of an expectations-augmented Phillips curve after a change in the price level*. We can therefore derive an equation specifying this process from our simple model. From (1) we have

$$(P - P_{-1}^e) = \frac{\mu - \alpha}{\beta} + \frac{\beta + \sigma}{\beta} (P - W)$$

Substituting this expression in (2) we have

$$W = \frac{\mu - \alpha}{\beta + \sigma} - \frac{1}{\sigma} X + P$$

where X is the excess demand for labour ($L - L^*$). Taking first differences**

$$\Delta W = -\frac{1}{\sigma} \Delta X + \Delta P$$

We assume that wage bargains are struck on the basis of expected prices, and that a fraction ϕ of the current level of excess demand is eliminated in one period. This requires $\Delta X = -\phi X_{-1}$, and $\Delta P = \Delta P_{-1}^e$. We then have

$$\Delta W = \frac{\phi}{\sigma} X_{-1} + \Delta P_{-1}^e$$

Since the level of employment is equal to the total population minus the level of unemployment, we can write

$$\Delta W = \frac{\phi}{\sigma} [U^* - U_{-1}] + \Delta P_{-1}^e \quad (3)$$

* We have in mind Friedman's original contribution to the subject. See Friedman (1968), pp. 9-10.

** For simplicity, we assume no change in productivity (i.e., $(\mu - \alpha)$ is constant).

where U^* is the level of unemployment associated with L^* -the so-called "natural" level of unemployment. Expression (3) is the expectations-augmented Phillips curve which will be used in our analysis.

Following Laidler (1973), we hypothesize that expectations are formed according to the "adaptive adjustment" mechanism, and that the money supply is exogenous and equal to the money demand, which in turn is proportional to the price level and a function of real income. We assume additionally that each level of real income corresponds to a given level of employment and is therefore associated with a given level of unemployment. These assumptions, together with the wage formation equation, can be written

$$\Delta W = g [U^* - U_{-1}] + \Delta P_{-1}^e \quad 0 < g < 1 \quad (4)$$

$$\Delta P^e = d \Delta P + (1-d) \Delta P_{-1}^e \quad 0 < d < 1 \quad (5)$$

$$\Delta M = \Delta P - b \Delta U \quad b > 0 \quad (6)$$

where $g = \phi / \sigma$.

Equations (4) to (6) form a disequilibrium system of three equations in four unknowns (ΔW , ΔP^e , ΔP , U). This is so because while the first equation has been specified in terms of nominal wages, the exogenous disturbances to the system are transmitted through prices. The additional equation required, relating wages to prices during the process of adjustment, is found by taking first differences of equation (1) and rearranging^a.

$$\Delta P = \Delta W + h [\Delta P - \Delta P_{-1}^e] \quad 0 < h < 1 \quad (7)$$

^a In Laidler's original model this equation was not required, because his model did not include the wage variable.

where $h = \beta / (\beta + \sigma)$. In equilibrium wages will change at the same rate as prices. Throughout the process of adjustment, however, they will differ*. The difference will be greater, the lower the elasticity of demand, and/or the higher the elasticity of supply.

The complete model is formed by equations (4) to (7) and has the same basic properties as Laidler's. In equilibrium, unemployment will be equal to its natural level and independent of the rate of monetary expansion ($U = U^*$). The rate of wage and price inflation, on the other hand, will equal the rate of monetary expansion, and expectations will be fully adjusted ($\Delta P = \Delta P^e = \Delta W = \Delta M$).

II.2. The Demand-Pull hypothesis.

The discussion of this hypothesis has to some extent been anticipated in our illustration of the model's disequilibrium properties. The price level increase which initiated the adjustment process described there can be interpreted as having arisen from an exogenous increase in the money supply. We identify this inflationary process with the demand-pull hypothesis.

The implications of this hypothesis for prices, wages, and employment have been widely reported, and our model gives the familiar results. It is convenient to break the analysis in two parts. We first examine the behaviour of the model in the short run, where expectations are held constant. Equation (5) is dropped from the model; ΔP^e is assumed constant. The system then has three equations - (4), (6), and (7) - in three unknowns - ΔP , ΔW , and U . Its equilibrium solution is given by

* Loosely speaking, we could say that during the process of adjustment wages will increase at a lower rate than prices. If the initial and final levels of the real wage are to be equal, however, some overshooting is implied. That is, the path of ΔW must be oscillatory.

$$U = U^* - \frac{1-h}{g} [\Delta M - \Delta P^e] \quad (8)$$

$$\Delta W = \Delta M - h [\Delta M - \Delta P^e] \quad (9)$$

$$\Delta P = \Delta M \quad (10)$$

In the new equilibrium position unemployment will be lower than at the initial point, since now ΔM will be larger than ΔP^e . The rates of wage and price inflation will no longer be equal; while prices increase in proportion to the money supply, wages will increase at a lower rate. Providing that the parameter g is sufficiently small relative to b and h , the system will converge towards the equilibrium specified by equations (8)-(10); the path of adjustment may be cyclical.

This adjustment can be followed diagrammatically in figure 2 where we plot the relationship between price inflation and unemployment implied by equations (4) and (7)*; we call this schedule PC. If we assume that before the exogenous increase, ΔM is equal to zero, then the initial equilibrium is at A, where $\Delta W = \Delta P = \Delta M$, and $U = U^*$. When the rate of monetary expansion increases to some positive level (ΔM_1), the rate of price inflation will increase proportionally (ΔP_1). With constant expectations, the Phillips curve does not shift and unemployment decreases (U_1). From equation (9), the rate of increase of nominal wages (ΔW_1) will be less than the rate of increase of prices, and the real wage will, therefore, be lower at B than at A. Under these assumptions, then, a trade-off exists between inflation and unemployment.

When price change expectations are allowed to adjust to actual levels, equation (5) must be reinstated. The equilibrium solution is now

* That is, $\Delta P = g/(1-h)[U^* - U_1] + \Delta P_1^e$.

$$U = U^* \quad (11)$$

$$\Delta W = \Delta P = \Delta P^e = \Delta M \quad (12)$$

Under these assumptions, unemployment will always return to the natural rate, and the real wage will also return to its initial value*. As before, only mild restrictions are needed to guarantee stability, and the adjustment path may also be cyclical.

In Figure 2 this process is depicted as a movement from B to D, the equilibrium point given by (11) and (12). From B, as expectations about price inflation begin to be revised in the light of actual rates of change, the Phillips curve starts shifting upward. Its equilibrium position is given by $PC_1(\Delta P^e = \Delta P_1)$.

The demand-pull hypothesis has been illustrated by means of a model in which the rate of monetary expansion is the exogenous variable. This basic model can be modified to represent a policy regime where the rate of monetary expansion is allowed to adjust to achieve a target level of unemployment. Such a system would converge only if a trade-off existed between inflation and unemployment (fixed expectations), or if the target rate chosen was in fact the natural rate. It is important to realise that such a modification does not contravene any of the assumptions of the demand-pull hypothesis. Any target rate below the natural rate implies the direct introduction of excess demand into the system, and it is this which is central to the idea of demand-pull.

* The dynamic model tells us only that in equilibrium, the rates of price and wage increase will be equal. It is the static model, from which equations (4) and (7) are derived, that guarantees equality with initial values.

III. The Cost-Push Hypothesis

III.1. The hypothesis

In considering the cost-push hypothesis, we restrict ourselves to influences arising from the participation of labour in the productive process*. Cost inflation, according to our definition, is associated with a situation where suppliers of labour insist on wage increases which are independent of the state of the market and expectations about price increases, and thus initiate a potentially inflationary process. We represent this by assuming that the supply of labour is dependent on an exogenous variable π , which acts as a proxy for all those social factors which the labour force, in whole or in part, brings to bear on the economy to gain higher wages. Accordingly, we modify the labour supply equation thus

$$L^s = \alpha + \beta (W - P_{-1}^e) - \pi$$

Equations (4) and (7) will consequently change to

$$\Delta W = g [U^* + \pi_{-1} - U_{-1}] + \Delta P_{-1}^e \quad (4')$$

$$\Delta P = \Delta W - k \Delta \pi + h [\Delta P - \Delta P_{-1}^e] \quad (7')$$

where $k = 1/(\beta + \sigma)$

This formulation of the hypothesis is in some sense equivalent to re-de-

* Other factors may also influence the cost of production of goods. For example, Hicks (1975) cites changes in the terms of trade as an influence of importance in initiating the present cost-inflation.

fining the natural rate of unemployment at a higher level: $U^{**} = U^* + \pi_{-1}$. This would be the end of the story if we treated π as a structural parameter, as Friedman does implicitly in his definition of the natural rate.

If π is treated as a variable, however, changes in its value may, under certain conditions, give rise to inflation. For this to occur, it is necessary that an exogenous increase in π be accompanied by an increase in the rate of expansion of the money supply. It is therefore convenient to envisage a policy regime such as that outlined at the end of Section II.

We will assume that the monetary authorities choose as their policy objective some target rate of unemployment U^t , and that they manipulate the rate of expansion of the money supply to achieve their target. In particular, we specify a government behaviour equation according to which a) the rate of expansion of the money supply will rise until the desired rate of unemployment has been achieved; and b) the rate of expansion of the money supply will be held at the level required to maintain the target, once it has been achieved.

$$\Delta M = \Delta M_{-1} + \gamma [U_{-1} - U^t] \quad \gamma > 0 \quad (13)$$

This is, of course, a crude simplification*, but it is nevertheless suffi-

* For at least three reasons. First, governments have means of changing unemployment rates which do not depend, directly at any rate, on the rate of change of the money supply. Second, the behaviour of governments towards targets is likely to be far more sophisticated than that embodied in our equation. Third, governments are likely to have other targets besides an employment target; in particular, a target for inflation itself seems likely.

cient to bring out the essential elements of the problem, while keeping the analysis simple.

III.2. The generation of Cost-Push inflations.

We have noted that changes in the value of π are not sufficient, on their own, to initiate an inflation. To see this more clearly, we first analyze a situation in which expectations about inflation and the rate of expansion of the money supply are kept constant at their initial level. The model is represented by equations (4'), (6) and (7'), and the three unknowns are ΔW , ΔP , and U . The equilibrium solution of the system will be given by

$$U = U^* + \pi = U^{**} \quad (14)$$

$$\Delta W = \Delta P = \Delta P_0^e = \Delta M_0 \quad (15)$$

The equilibrium rates of price and wage inflation will not be affected, and the level of unemployment will increase, depending on the new value of π . The system will necessarily converge to a solution, and the path of adjustment will be monotonic. In figure 3, we assume that the initial situation was one of stable prices, and we represent the adjustment by a movement from A to E. In the process, while $\Delta\pi > 0$, ΔW will be larger than ΔP , as indicated by equation (7'). Since the adjustment is monotonic, it follows that although the rates of increase of prices and wages will eventually be the same, the level of the real wage at E will be greater than at A. There is a certain symmetry between the point B of figure 2 and the point E of figure 3. There, the government was able to reduce unemployment, with an associated reduction in the real wage; here, the workers succeed in increasing their real wage, at the cost of a higher level of unemployment.

We now allow workers' expectations about prices to adapt to actual values,

by reinstating equation (5), and we assume the government will react to achieve and maintain the target level of unemployment U^t , by introducing equation (13). The full model is specified by equations (4'), (5), (6), (7'), and (13). The outcome now depends crucially on the value of U^t .

Let us assume that initially U^t is set equal to U^* . The exogenous increase in π will, as above, move the economy to E in figure 3. The operation of the reaction function (13) will then lead the economy to F, where $U = U^t = U^*$. As expectations adapt to the new rate of inflation, however, the schedule $PC_1 (\Delta P^e = 0; \pi = \pi_1)$ will shift to $PC_2 (\Delta P^e = \Delta P_1; \pi = \pi_1)$, moving the economy to G. As long as the authorities are committed to a level of unemployment of U^* , the rate of inflation will continue to increase, and thus the model has no solution. It should be noted that the introduction of a target of inflation into the reaction function would not alter this process in any essential respect, as long as the achievement of U^* continues to have some weight as a government objective. The rate of inflation will cease to rise only if π returns to its initial value, or U^t is raised to U^{**} , or some compatible combination of these two changes is achieved. In all cases, a higher rate of (anticipated) inflation will prevail than was present before the process was initiated. Unless π returns to its initial level, the new rate of unemployment will also be higher.

This tendency of the unemployment level to increase under cost inflation is seen more clearly if it is assumed that π does not rise once and for all, but continues to increase in value, and that the government adjusts its unemployment target to U^{**} , but with some delay*. Figure 4 depicts schematically

* This assumption is not implausible, and it generates movements of the inflation rate and the unemployment level similar to those experienced recently in the U.K.

the resulting process of a system subject to shocks of this kind, and its interpretation follows from the argument used for Figure 3. The simultaneous increase of ΔP and U suggests a possible test for discriminating between demand-pull and cost-push inflations, which is discussed in section IV.

IV. Implications.

In this section we will first discuss the policy implications of our analysis, and then consider whether the two kinds of inflation can be empirically distinguished.

In the case of a demand-pull inflation, the expected policy prescriptions hold: aggregate demand management, by means of money supply control and, perhaps, a correct selection of the natural rate of unemployment. With a cost-push inflation, however, a somewhat different policy package is suggested. Action may be taken to reduce the level of π , our proxy for the social and political factors responsible for the inflation.

Although these factors are labelled "social and political", they may in fact be closely related to economic forces, and economic policy may be effective in countering them. For example, suppose that perceived income inequality is the "social" force responsible for initiating a cost inflation. The introduction of a flat-rate incomes policy - such as the U.K.'s £6 pay limit - may reduce the rate of such an inflation, not through its impact on expectations, but through the pressure it exerts on perceived notions about the distribution of income and the way it is changing. The control of the money supply, or the choice of a "correct" target unemployment level, is necessary for the control of inflation, whatever its origins. But our analysis suggests that they may not by themselves be sufficient in the cost-push case, without generating unacceptably high levels of unemployment. The introduction of π as a

variable implants an additional potentially destabilizing factor in the system, but it also provides policy makers with an additional handle on its control. It seems likely that the value of π may be influenced by both existing and new policy instruments. To put it another way, the "correct" unemployment level in a cost-push situation is no longer a parameter determined by the structure of the system, but a changing variable which ^{might} ~~can~~ be controlled by taking the right course of action.

It is, then, important to have some means of determining whether a given inflation is of the demand-pull or cost-push kind. It was suggested at the end of section III that simultaneous upward movements of the rate of price change and the unemployment level - "stagflation" - is likely to have been initiated by cost-push forces, while an inflation in which unemployment does not rise much above the natural rate is more likely to be of the demand-pull kind. However, no absolute criteria for discrimination exist in the context of our model, because of the difficulty of determining the natural rate (in the structural sense of Friedman), and the complications of cycling adjustment paths.

It should be pointed out, however, that the cost-push variant of the model presented here was formulated as an analytic aid to intuition. It was not designed to represent reality in the specific fashion required of models which are to be empirically estimated. More complex formulations may suggest empirical tests of discrimination not revealed by our simple model, as well as generating more reliable and specific policy recommendations.

REFERENCES

- FRIEDMAN, M. (1968). The Role of Monetary Policy. American Economic Review, 43, 1-17.
- HICKS, J.R. (1974). The Crisis in Keynesian Economics. Oxford: Blackwell.
- (1975). What is Wrong with Monetarism. Lloyds Bank Review, no. 118, 1-13.
- JONES, A. (1973). The New Inflation: The Politics of Prices and Incomes. London: Deutsch.
- LAIDLER, D.E.W. (1973). The Influence of Money on Real Income and Inflation; A Simple Model with Some Empirical Tests for the United States, 1953-1972. Manchester School, 41, 367-95.
- LAIDLER, D.E.W. and M. PARKIN (1975). Inflation - a Survey. Economic Journal, 85, 741-809.
- WILES, P. (1973). Cost Inflation and the State of Economic Theory. Economic Journal, 83, 377-98.

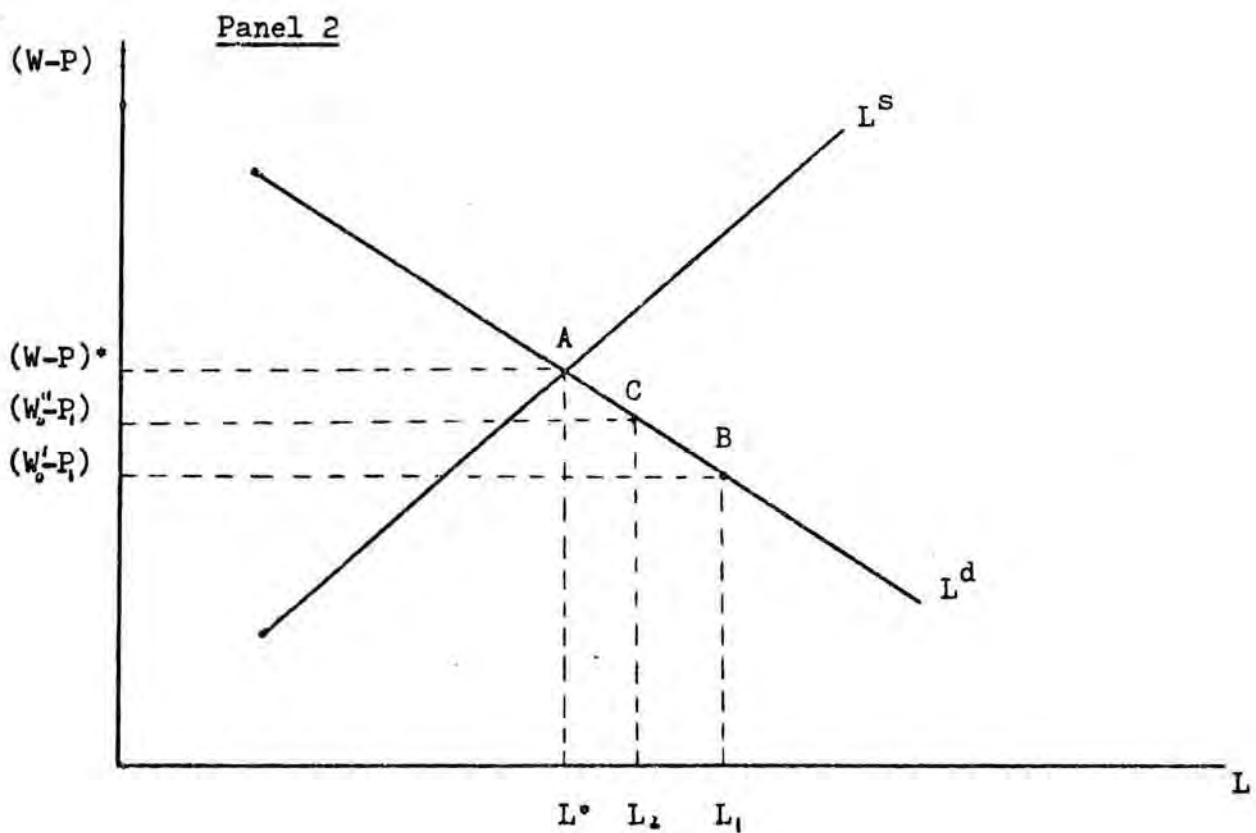
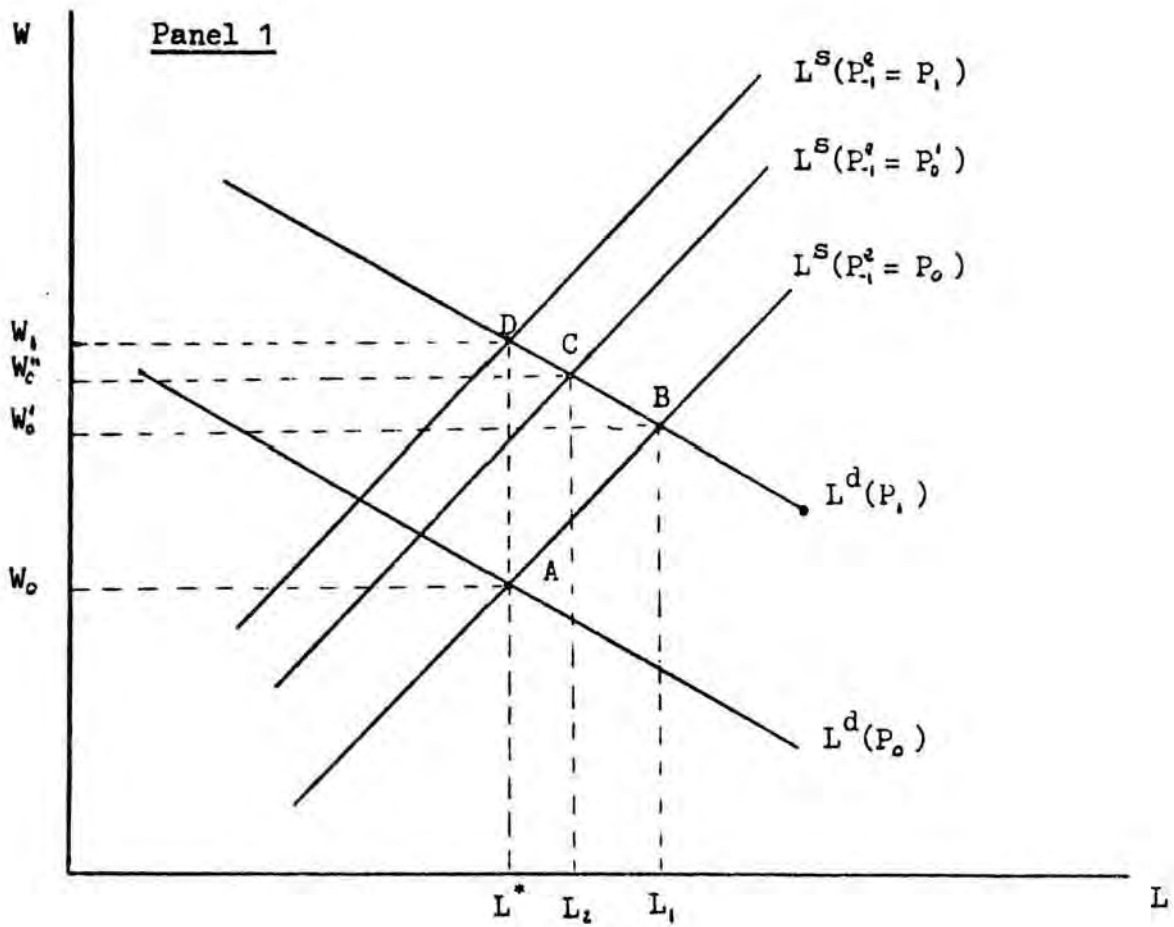


Figure 1. The Market for Labour Services.

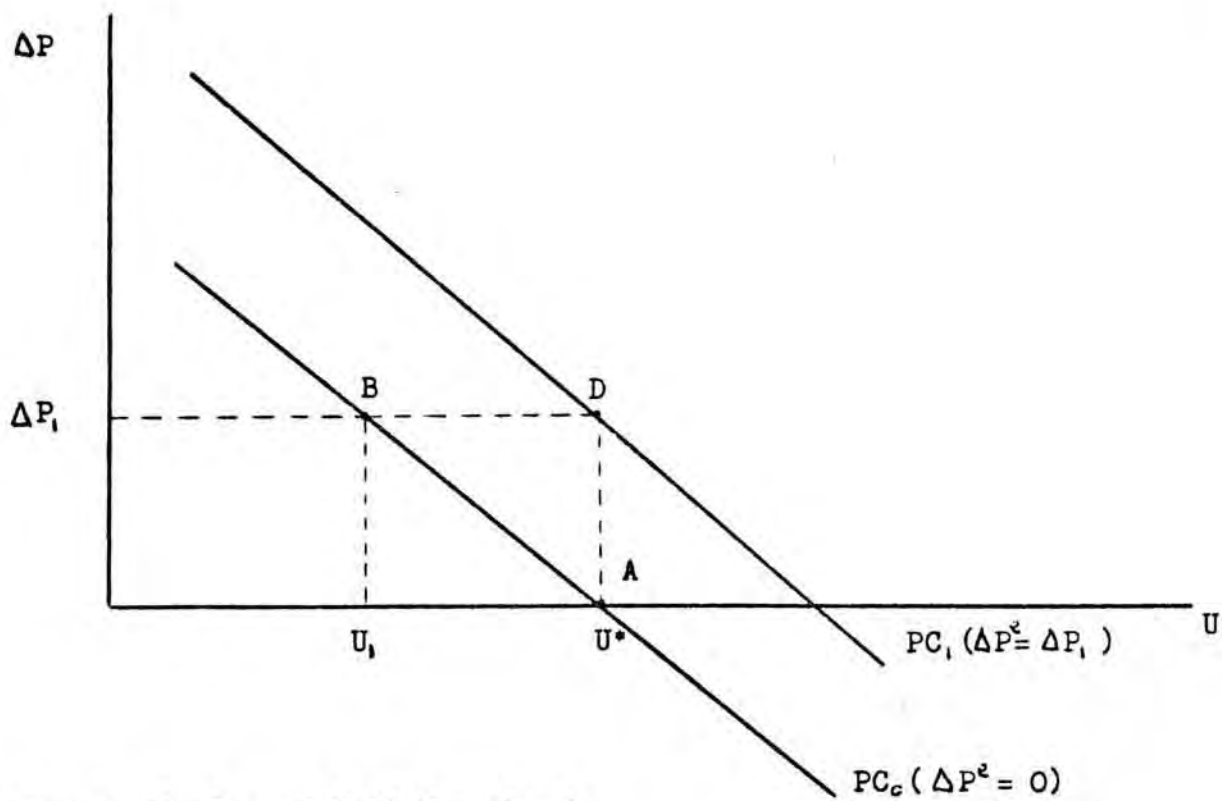


Figure 2. The Demand-Pull Hypothesis

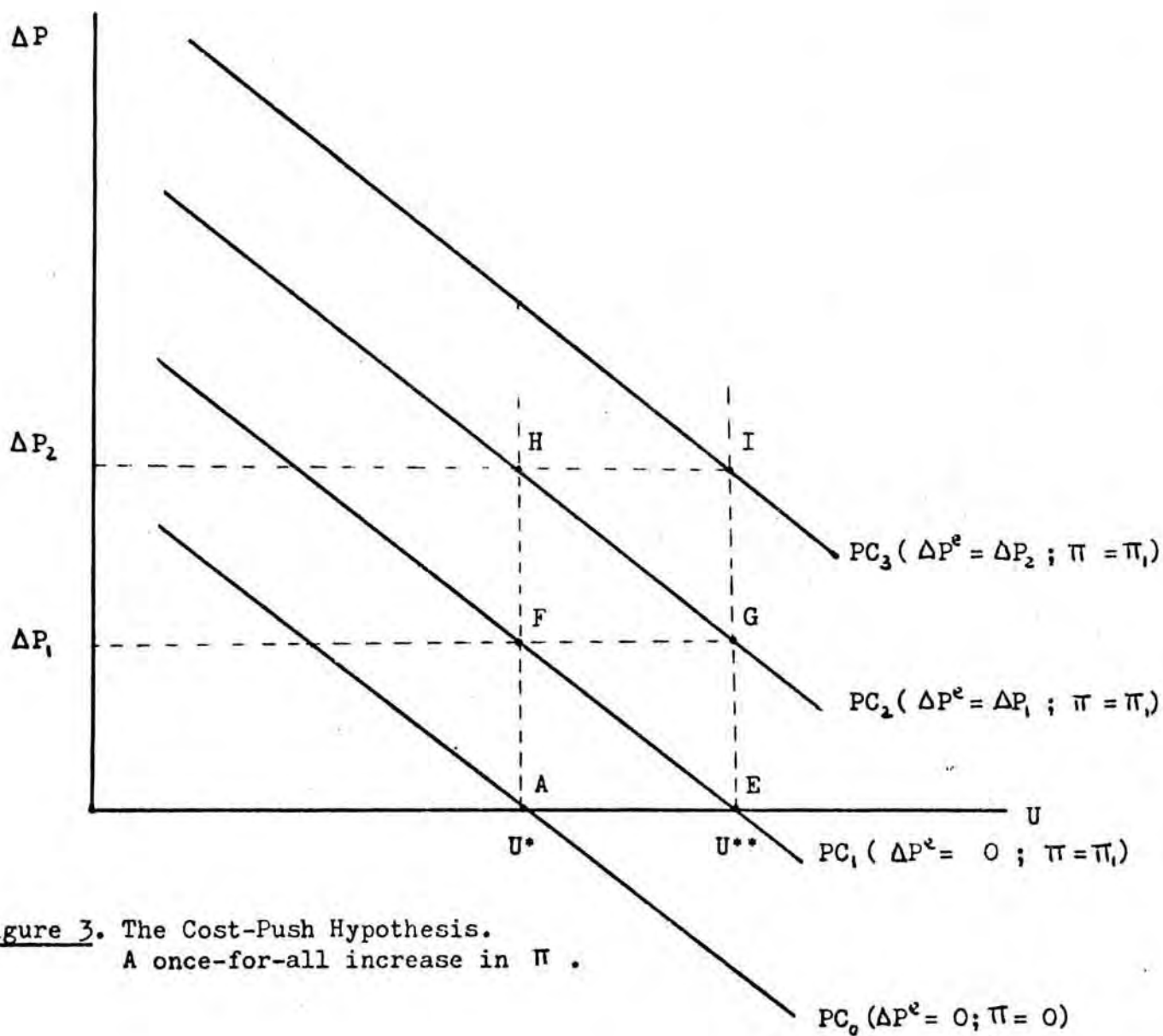


Figure 3. The Cost-Push Hypothesis.
A once-for-all increase in π .

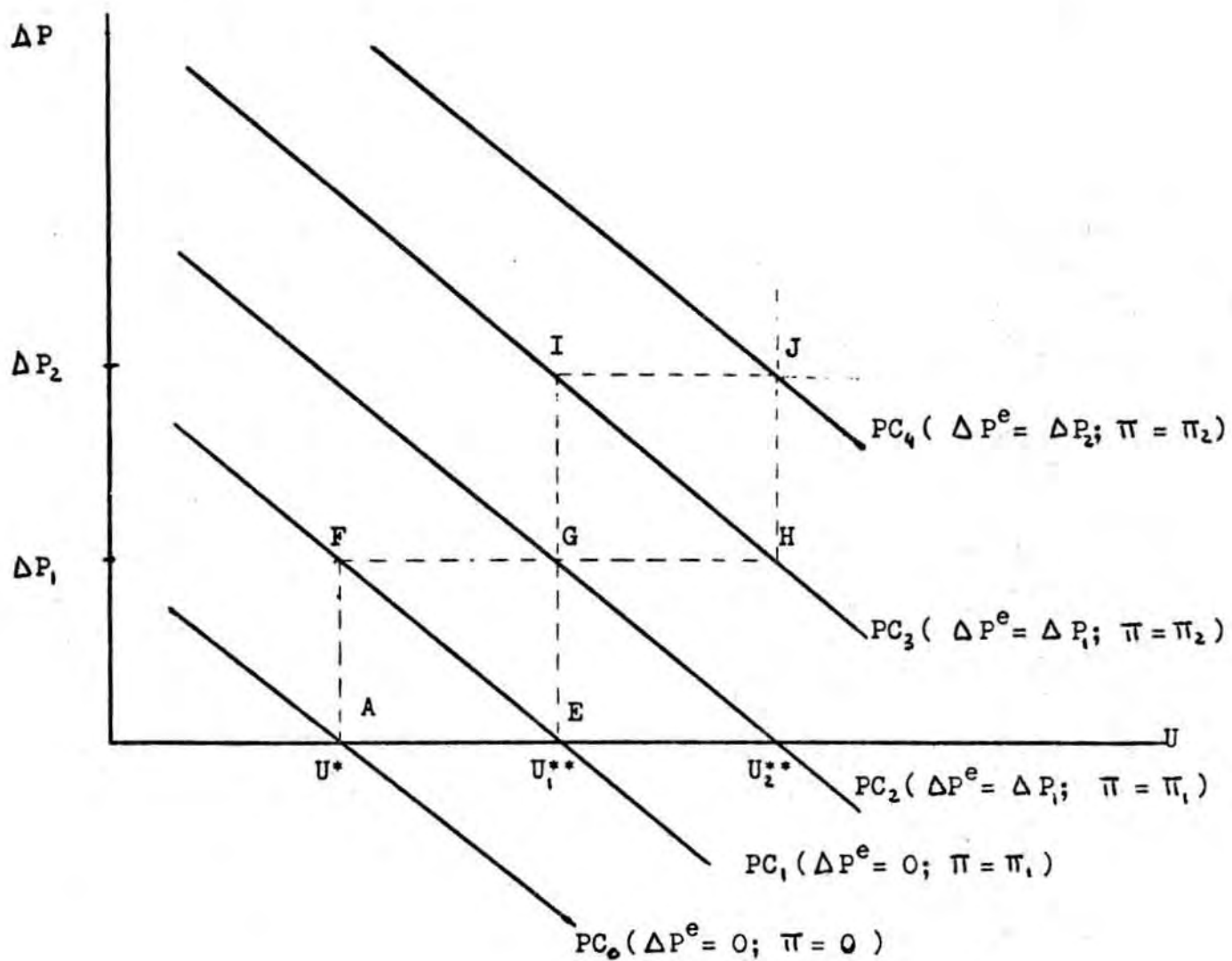


Figure 4. The Cost-Push Hypothesis.
A sustained increase in the variable π .